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14. ABSTRACT
We have prepared thermoelectric devices from alternating layers of Si/Si+Sb superlattice films using ion beam assisted deposition (IBAD). In order to determine the stoichiometry of the elements and the thickness of the grown multi-layer film, Rutherford Backscattering Spectrometry (RBS) and RUMP simulation have been used. SEM and EDS have been used to analyze the surface and composition of the thin films. The 5 MeV Si ion bombardments have been performed using the AAMU Pelletron ion beam accelerator, to make quantum clusters in the multi-layer

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Report Title

High Energy Effects on Thermoelectric and Optical Properties of Si/Si+Sb Nanolayered Thin Films

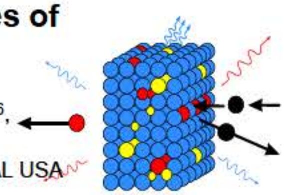
ABSTRACT

We have prepared thermoelectric devices from alternating layers of Si/Si+Sb superlattice films using ion beam assisted deposition (IBAD). In order to determine the stoichiometry of the elements and the thickness of the grown multi-layer film, Rutherford Backscattering Spectrometry (RBS) and RUMP simulation have been used. SEM and EDS have been used to analyze the surface and composition of the thin films. The 5 MeV Si ion bombardments have been performed using the AAMU Pelletron ion beam accelerator, to make quantum clusters in the multi-layer superlattice thin films to decrease the cross plane thermal conductivity, increase the cross plane Seebeck coefficient and increase the cross plane electrical conductivity to increase the figure of merit. Some optical instrumentations have been used addition to RBS and SEM.

Conference Name: MRS Spring 2013 (H: Nanoscale Thermoelectrics—Materials and Transport Phenomena - II)

Conference Date: April 01, 2013

High Energy Effects on Thermoelectric and Optical Properties of Si/Si+Sb Nanolayered Thin Films



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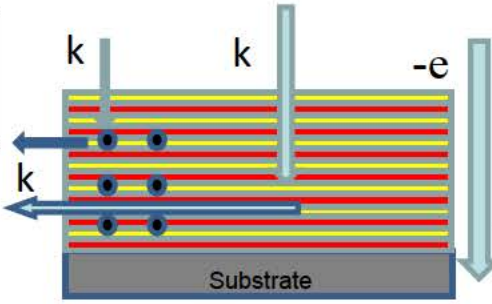
OBJECTIVES:

To tailor the thermoelectric and optical properties of Si/Si+Sb Nanolayered Thin Films

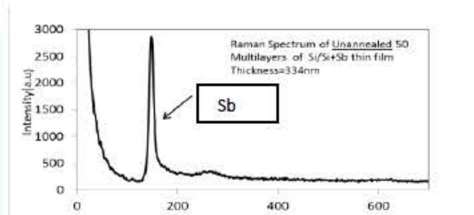
Important Parameters

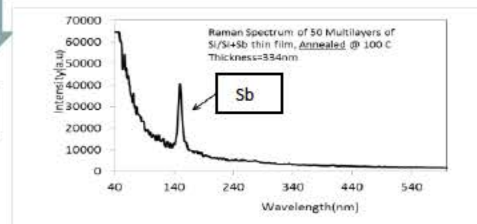
- **S** Seebeck coefficient,
- **σ** Electrical conductivity,
- **T** Temperature,
- **κ** Thermal conductivity.

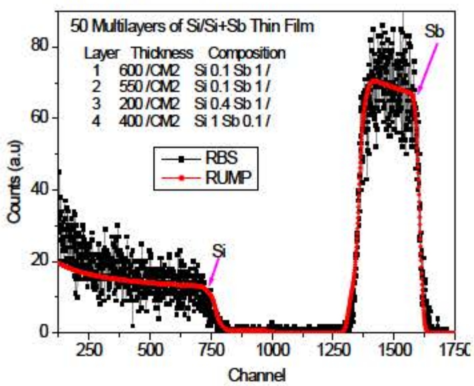
$ZT = S^2\sigma T/\kappa$ Figure of Merit
(Efficiency approaches Carnot Limit for high Figure of Merit)



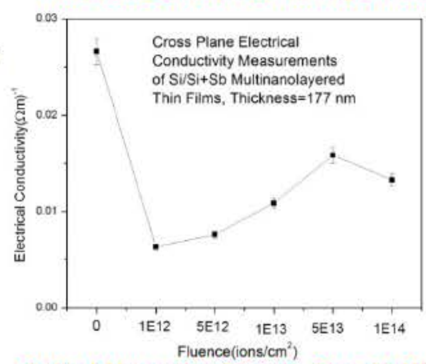
Ion Beam Assisted Deposition

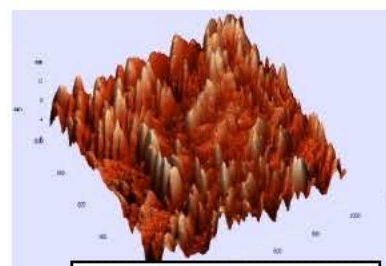




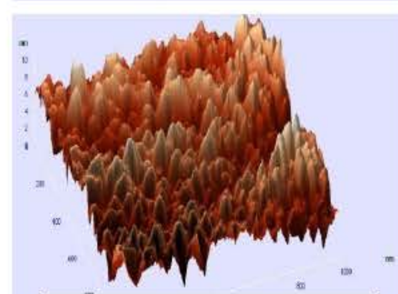


Four probe Electrical Conductivity Results from 20 ML of Si/Si+Sb multilayer films





AFM of Unannealed Si/Si+Sb Thin Film



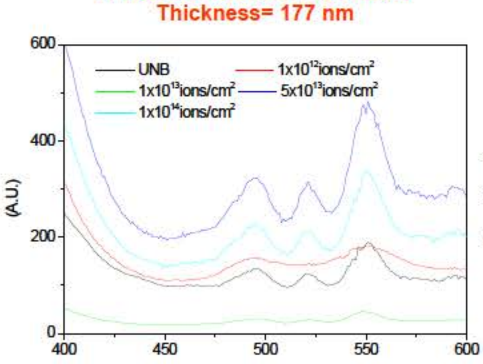
AFM of Si/Si+Sb Thin Film, Annealed @100°C

Initial Measurements:

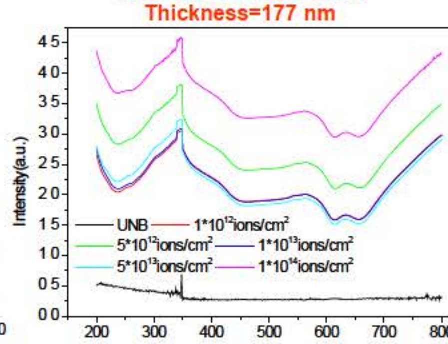
- Four Probe method for electrical conductivity
- Optical Absorption
- Photoluminescence
- AFM, RBS, Raman, Seebeck

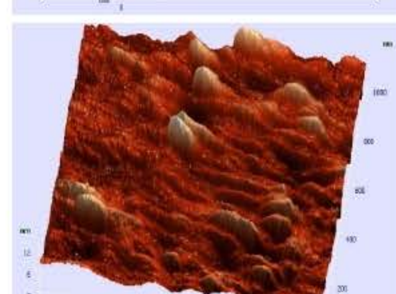
S= -46 μV/K for unannealed 50 ML thin film

Photoluminescence Spectra From 20 ML of Si/Si+Sb multilayer films Thickness= 177 nm



Optical Absorption Spectra From 20 ML Si/Si+Sb multilayer films Thickness=177 nm





AFM of Si/Si+Sb Thin Film, Annealed @200°C

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